Some Natural Antioxidants Sources From Foods And Tree Barks

Ahmed M A Hamad

ABSTRACT: Oxidation is a common reaction that takes place during preparation of different foods. It takes place through transferring electrons from a chemical compound to other/s. Researchers believe that oxidation has negative impact on human health. Moreover, existence of anti-oxidants in any food means existence of substances, which can delay or stop the oxidation process, as oxidation not only affects health but also deteriorates the natural flavor of any food. Some anti-oxidants are natural but others are synthetic. Natural anti-oxidants, commonly denoted as NAOs, are preferential choice of doctors and customers. They exist in multiple food sources including vegetables, fruits, and other plant-based and animal-based diets. In this article, we have described only those oxidants, which can be obtained through natural sources

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Keywords: Oxidation, natural anti-oxidants, phenolic acids

1 INTRODUCTION

The definition of antioxidants is any substance that when present at low concentrations compared with that of an oxidizable substrate significantly delays or inhibits oxidation of that substrate". Halliwell and Gutteridge1995 and specific definition, that an antioxidant is "any substance that delays, prevents or removes oxidative damage to a target molecule" (Halliwell 2007) Anti-oxidants perform as oxidation-inhibitors, even when they are applied with low concentration (Mandal et al., 2009), they have definitive physical impact on the health of people using them. They are significant for preventing the health damage, which is caused by polluted plants, and for preventing diseases in both animals and plants. (Ahmed & Beigh, 2009) they play a vital role by supporting the defense mechanism of the body. Anti-oxidants mainly contain chemical/biochemical compounds, which control, formation of free radicals in the body and in the process; they stop oxidation chain formation as well. In other words, they are a natural solution to stress caused by environmental or physical factors including ageingCancer and atherosclerosis (Maestri et al., (2006) Researchers think that antioxidant-rich foods can provide a certain level of protection from the damage caused by free radicals present in food as well as the human body. They can be life-saving because they protect the human body against cardiovascular problems, nucleic acid damage, and many other body-deterioration processes. (Yanishlieva-Maslarova & Heinonen, 2001)

2. Antioxidant

Anti-oxidants can be either natural or synthetic but primarily they have poly-substituted phenolic structures. Since phenolics can be found in all parts of plants, we can easily assume that the natural anti-oxidants are also present in the whole plants including their fruits and seeds (Pandey, & Rizvi, 2009) The most current research on antioxidant action focuses on phenolic compounds such as flavonoids. Fruits and vegetables contain different antioxidant compounds, such as vitamin C, vitamin E and carotenoids, whose activities have been established in recent years.

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Flavonoids, tannins and other phenolic constituents present in food of plant origin. (Record, et al, 2001). It is proven in many medical studies that free radicals are largely responsible for most cancers and degenerating diseases including impairment of the brain function. First, some naturally occurring substances were tried but later (Lobo, et al, 2010) They were replaced with synthetic products as they were cheap, their supply was not limited, and they showed reasonable anti-oxidant function. Some antioxidants are legally sold but they are just a few and they include tert-butyl hydroquinone (TBHQ), butylated hydroxytoluene (BHT), propyl- and dodecylgallate, thiodipropionic acid, butylated hydroxyanisole (BHA), tocopherols, ascorbyl palmitate, carotene, lecithin citric acid, lecithin, and silicone oil (Yanishlieva-Maslarova & Heinonen, 2001). (Gülçin, 2012). Artificially produced anti-oxidants can be sold only if: They do not contain any toxic element and they must be effective as anti-oxidants despite minimum concentration Since many anti-oxidants are not like proteins as per their structure and properties, they are stable compounds in synthetic forms and they easily penetrate in the cells, so their doses can be orally given and managed (Belitz et al., 2009; Li, 2011). Anti-oxidants exist in the form of enzymes, proteins and other molecular forms. Food products are rich sources of anti-oxidants, nutrients and necessary trace elements. Most common anti-oxidants include vitamin E and flavonoids, which are phenolic substances. Scientists have developed many types of synthetic anti-oxidants and they are prescribed as supplements or as drugs in case of their deficiency. Most of the naturally occurring phenolic substances/compounds are now available in synthetic forms but still, it is a universally accepted fact that naturally occurring antioxidants are comparatively better, effective, and safer (Yanishlieva-Maslarova & Heinonen, 2001). Yadav, et al. 2016) BHAs and BHTs are popular and commonly used anti-oxidant varieties. For overcoming stability issues including the issue of frying oil, which somehow, makes them unstable, synthetic antioxidants are used as food supplements but some latest studies provided significant evidence that they can play a role like carcinogens. During the recent years, the scientists have been searching for effective compounds having low or no toxicity, and they must be able to perform as Intense anti-oxidants. α-tocopherol, which is a very effective vitamin E form but it is observed that its natural form has higher potency than its synthetic form. It is also a researched fact that human body more easily absorbs natural anti-oxidants that the synthetic ones. Customers normally prefer natural anti-oxidants and besides, regulating and legislative authorities easily approve

their sale (Gohari Ardabili et al., 2010) (Atta, et al 2017) There is no guarantee that if an anti-oxidant is found in food, it is completely non-toxic because it might have some toxic, carcinogenic, or mutagenic compounds. Many synthetic anti-oxidants have been tested and results show their harmful effects but on the other hand, natural foods aren't specifically tested for these effects (Pokorny, 1991). (Lobo,., et al 2010) Natural antioxidant, can Classified as phenolic compounds are divided in 6 sub-groups (lignans, courmarins, stilbenes, flavonoids, phenolic acids and tannins). (Shahidi., & Ambigaipalan, 2015)

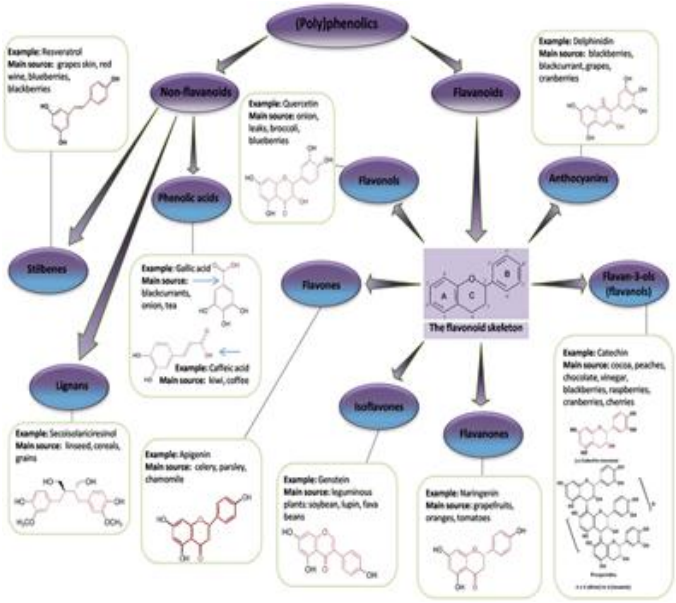

Figure 1 *Classification of phenolic antioxidants (Goszcz,, et al. 2015).*

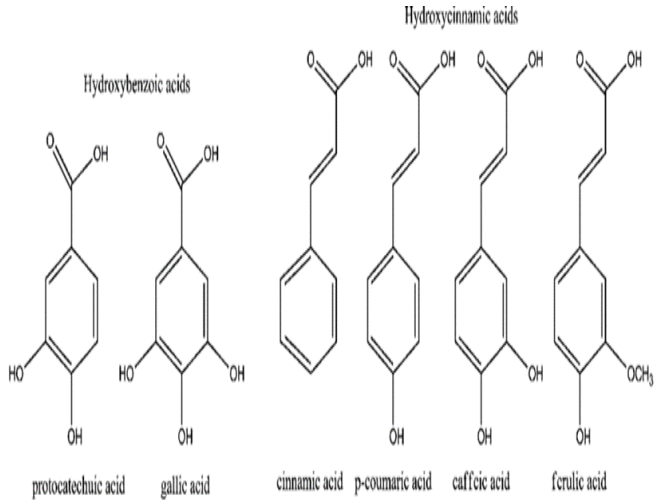

Figure 2. *Chemical structure of selected phenolic acids (Lojek et al 2014).*

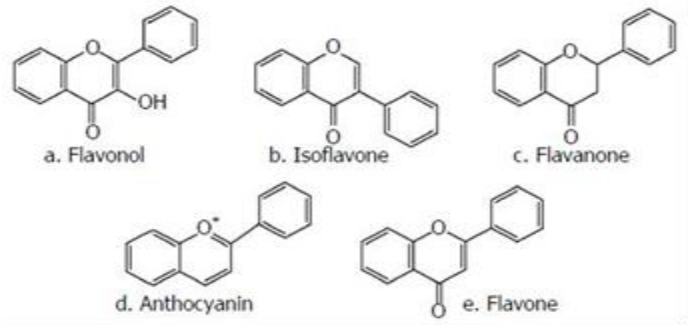

Figure 3. *Chemical structure of main flavonoid subclasses (Salaritabar, et al. 2017)*

2.1Antioxidants from legumes, nuts and oilseeds

Plants are a major and basic source of natural anti-oxidants, and that is why, vegetarian diet is good for reducing their deficiency. Plant-based phenolics perform multiple functions in human and animal bodies including termination of free radicals, reduction of metal chelators and reduction/control of oxidation processes. Mathew and Abraham, (2006). Small amounts of selenium and the vitamins, which are soluble in water, exist in animal-based diets including milk, fish, and eggs but their quantity depends on the type of fodder/food the animals eat; therefore, animal-based diets are insignificant anti-oxidant sources for humans (Yadav, A., et al 2016) Fruits, vegetables, nuts, seeds, fl owers, and bark. Many phenolic compounds have been reported to possess potent antioxidant activity and to have anticarcinogenic/antimutagenic, antiatherosclerotic, antibacterial, antiviral, and anti-in fl ammatory activities (Veeriah et al. 2006 ; Baidez et al. 2007 ; Han et al. 2007 Different studies show that the vital anti-oxidant sources are fruits, vegetables, green/black teas, beer, coffee, some wines, spices, whole grains and herbs (Parashar et al., 2014) (Sardarodiyan, & Mohamadi Sani, 2016). Many studies were conducted on anti-oxidant substances in legumes including chickpeas, peas, lentils, and beans (all types including fava, beach, yello and soya beans). (Wang et al., 2011) It was discovered that polyphenolics and phenolic acids were found in peas, peanuts and beans. Red peanut skin had 7 to 9 percent procyanidins, half of which were low-molecular-weight phenolic oligomers. Procyanidins with water-soluble property had β (4→8) /β (4→6) bond arrangements with capability to terminate 2,3-trans-flavan-3-ol catechin (Yanishlieva-Maslarova & Heinonen, 2001). tocopherols were found; these seeds include soya beans, cottonseed, canola, sunflower seeds, and flaxseeds (Maestri et al., 2006).

2.2 Antioxidants from Cereals

Cereals commonly consumable foods. In many places, they are staple foods for breakfast. They can be added to many foods. Phenolic acids are polyphenols, which are present in cereals. Ferulic acid is another important anti-oxidant found in grains like rye and wheat. Vanillic and p-coumaric acids are important anti-oxidants but they are found in trace quantities in grains. Oats contain polyphenols named as avertramidin and buckwheat contains rutin (Vollmannova et al., 2013). Barley is an important food grain and it contains significant quantities of tocotrienols and tocopherols i.e 206mg/kg of anti-oxidants are found in Barley. Buckwheat and gram seeds contain 387 and1315mg/100g flavonoids, and47- 77mg/100gram of rutins

in seeds and hull respectively. The anti-oxidants found in corn are very different mainly because carotenoids are a significant proportion of these anti-oxidants, which do not exist in significant quantities in other seeds/cereals. Carotene and xanthophyll are found in yellow corn. Their quantities are 2.7 and 19.9 ppm, respectively (Sikora et al., 2008). Cereal grains also contain catechins and their quantity is much higher in buckwheat, rye, and oats but they have least quantity in wheat. (Peterson et al., 2001) Rice bran oil has 0.1 to 0.14 percent vitamin E and it contains 0.9 to 2.9 percent oryzanol, 607-ppm tocols including 265ppm tocotrienols and 343ppm tocopherols, and 2846 ppm oryzanols (Yanishlieva-Maslarova & Heinonen, 2001)

Table 1*The analyses of nuts, legumes, and grain products in the Antioxidant Food (Carlsen, M. H et al 2010)*

No	Name of plants	Antioxidant content mmol/100 g
1	Barley, pearl and flour	1
2	Beans	0.8
3	Bread, with fi ber/whole meal	0.5
4	Buckwheat, white fl our	1.4
5	Buckwheat, whole meal fl our	2
6	Chestnuts, with pellicle	4.7
7	Crisp bread, brown	1.1
8	Maize, white flour	0.6
9	Millet	1.3
10	Peanuts, roasted, with pellicle	2.0
11	Pistachios	1.7
12	Sun flower seeds	6.4
13	Walnuts, with pellicle	21.9
14	Wheat bread, toasted	0.6
15	Whole wheat bread, toasted	1.0
16	Pecans, with pellicle	8.5

2.3 Antioxidants from fruits and vegetables

Fruits are rich sources of minerals, vitamins, and fiber. Most of the fruits have plenty of vitamin C, polyphenolics, and carotenoids. Apples are rich In anti-oxidants and they are anti-cancer as well because they control proliferation of cancerous cells in human body. Moreover, they reduce oxidation of lipids and significantly reduce cholesterol. Potatoes also contain highly considerable quantities of ascorbic acid, α-tocopherol and polyphenolic substances. (Calado, et al 2015). Many studies proved activity of anti-oxidants in potatoes, which takes place because of phenolic compounds. Cabbage is another source of more than 20 anti-oxidants including kaemferol and quercetin. In onions, anti-oxidant activity is high and they provide defense against lipid oxidation and free radicals. Red and yellow onions have lower anti-oxidant activity against methyl linoleate while they highly oxidize LDL cholesterol (Yanishlieva-Maslarova., & Heinonen, 2001). (Mlcek, et al 2015) Green tea is another food substance, which is laden with anti-oxidants besides pigment, vitamins, caffeine, tannin, and essential oil. Important anti-oxidants in the tea include cholophylls and carotenoids. Chlorophyll is a substance found in all leafy greens but when green tea is heated, processed and stored, it turns into pheophorbide and phenophytin, which are responsible for anti-oxidant activity (Farooq, & Sehgal, 2018) (Kusmita et al., 2015). Lettuce is another vegetable with high anti-oxidant content as it contains 236mg/kg quercetin glycoside while kale has as high Kaempferol glycoside as 250mg/kg. Pumpkin seeds are another source of anti-oxidants. Researches show that they have anti-cancer and anti-mutagenic properties (Yanishlieva-Maslarova ., & Heinonen, 2001). (Gran & Azrina, 2016) Black peppers certainly contain some anti-oxidants and they have radical scavenging properties but those properties were not accurately filed or mentioned in researches so far (Khalaf et al., 2008) (Gülçin, 2005). The anti-oxidant profiles of vegetables are reasonably higher. Red peppers, brassica, onions, red beetroots, garlic and tomatoes serve as ideal sources of anti-oxidants. Red peppers provide very high vitamin C content, which can be as high as 144mg/100g, luteonlin, apigenin, and cryptoxantin content. (Materska &Perucka, 2005). Tomatoes provide lycopene in reasonable quantities and most of the total lycopene exists in the peel, which is almost 3026µg/100g but if tomatoes are preserved in any form like ketchup, the lycopene content increases to a great extent i.e. in ketchup, it is 9900µg/100g (Lugasi et al 2003). Researchers have discovered some new forms of anti-oxidants while conducting experiments on spinach. Spinach extract, also called as NAO, contains flavonoids and p-coumaric acid, which are notable anti-oxidants. (Shebis et al., 2013)

Table 2 *The berries, fruit, and vegetable analyses in the Antioxidant of Food (Carlsen, et al 2010)*

No	Name of plants	Antioxidant content mmol/100 g
1	Apples	1
2	Apples, dried	3.8
3	Apricots, dried	3.1
4	Artichoke	3.5
5	Bilberries, dried	48.3
6	Black olives	1.7
7	Blueberry jam	3.5
8	Broccoli, cooked	0.5
9	Chili, red and green	2.4
10	Curly kale	2.8
11	Dates, dried	1.7
12	Dog rose, products of dried hip	69.4
13	Fruit from the African baobab tree	10.8
14	Mango, dried	1.7
15	Oranges	0.9
16	Papaya	0.6
17	Plums, dried	3.2
18	Pomegranate	1.8
19	Zereshk, red sour berries	27.3
20	Strawberries	2.1

Sterols are another family of significant anti-oxidants and they are significant because they help preventing oxidation and resulting degradation/quality problems of food oils. Anti Oxidants found in sunflower seeds are tocopherols, phenolic acids and sterols. Tocopherols are a type of phenolic anti-oxidants, so naturally, they are found in vegetable oil and they help against oxidation as they terminate formation of free radicals (Gohari Ardabili et al., 2011). Sunflower oil has 432.3±86.6 and 92.3±9.5 and β-tocopherols, which means that they comprise 3 percent of the total quantity of the sunflower oil. (Grilo, Costa, et al 2014) Stigmasterol, campesterol Δ7-stigmasterol, and Δ5-/Δ7-avenasterols are some other significant sterols found in food. They stop oil polymerization

and degeneration during the food frying process. Tocopherols act as hydrogen sharing and free radical blocking anti-oxidants, which help excessive fat eaters. Soybeans have is flavonoids, which are their major anti-oxidants (Yanishlieva-Maslarova & Heinonen, 2001). That hydrolysable polyphenols in grains are 85% of total polyphenols and contribute 95% of the total antioxidant properties, which indicates that hydrolysable polyphenols represent an important fraction of polyphenols in cereals. (Durazzo, et al 2015)

2.4 Antioxidants from Tree Barks

pine bark contains high levels of natural polyphenols with various biological activities, making this material an attractive source of raw materials used in the fields of nutrition, health, cosmetics and medicine (Ku & Mun, 2008). Most of the chemicals present in plant bark, especially tannins and phenolic compounds, are natural antifungal substances (Ghosh 2013) Antioxidants are therefore effective in preventing many diseases and are becoming increasingly important in pharmacology. The antioxidant activity of wood and bark extracts is thus interesting. In order to get antioxidant results in broad range, (Gao, 2007). Bark compounds exhibit various physiological activities, including free radical scavenging antibacterial, anti-inflammatory, anti-carcinogenic, and many other therapeutic and nutraceutical properties (Rosales-Castro et al. 2017). Several types of plant materials, such as vegetables, fruits, seeds, hulls, wood, bark, roots and leaves have been examined as potential sources of antioxidant compounds. The crude extract of bark contains a wide variety of phenolic compounds. Studies on the investigation of its bark and characterization have been reported (Soong & Barlow, 2004) Many studies have focussed on natural antioxidants from fruit, vegetables and medicinal plants. The results obtained may be related to high prevalence of oxidative diseases as well as the lethal effect of some synthetic antioxidants. Medicinal plants play a vital role in the treatment of many oxidative-related problems. Bark and leaf extract of the plant revealed that these parts of the plant held the most potent antioxidant activity. (Abdulkadir, Mat, & Jahan,. 2017). Antioxidant activity of crude drugs obtained from leaf, stem bark and fruit of Gardenia latifolia Aiton (Family- Rubiaceae) Contents of total phenolics, flavonoids and tannins were found higher in bark than that of leaf and fruit parts of this plant Similar trend was also found in total antioxidant activity where maximum antioxidant potential is measured in case of bark is more potent than the leaf and fruit parts in respect of its phytochemical content and antioxidant activity. Bark is known to accumulate large amounts of polyphenolic compounds which exhibit a wide range of biological effects, including antioxidant, antibacterial and anti-inflammatory activity (Ferreira et al.(2015);(Dedrie et al. 2015) Bark trees showed higher phenolic content and better scavenging activity. The ethanolic extracts from bark of young trees show good an-tioxidant activity (Rosales-Castro, 2015) phytochemical screening strongly suggested that there was a strong association between high free radical scavenging and amount of antioxidant compounds, particularly polyphenols in wood bark (Saefudin, , Basri, , & Sukito, 2018) a high concentration of total phenols was found in the Quercus sp. bark crude extracts, including different classes of phenolic compounds, like flavonoids, hydroxycinnamic acids, and proanthocyanidins, confirming that the Mexican species oak barks analyzed a good source of phenolic compounds (Valencia-Avilés, et al 2018) Terminalia superba bark contains chemical molecules such as tannins (catechics, gallic), alkaloids, flavonoids, saponosides, mucilages, reducing compounds, free anthracenics. These active ingredients are used in the treatment of certain human pathologies (Kougnimon Fifamè Espérance Elvire et al 2018)

3. Conclusion

This study started with the information that anti-oxidants are healthy and life-friendly compounds with capability to fight diseases like cancer and physically deteriorating oxidation processes. They are available in two forms: natural and synthetic. Studies show that natural anti-oxidants are safer, easily consumable and healthier as compared to synthetic chemical-based anti-oxidants. In this article, we highlighted some significant natural anti-oxidant sources including fruits, vegetables, legumes, nuts, cereals, spices, oilseeds and Tree bark We also mentioned the names, kinds, classification and quantities of significant anti-oxidants in each case. After the whole discussion and research-based facts, we can conclude that oral consumption of these compounds using natural anti-oxidant products have a positive impact on human health; therefore, we recommend their regular usage as part of the daily diet.

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